in the past, of considering a degree in one part of the temperature scale the equivalent of a degree at any other part of the scale, as is done in the use of the annual mean temperature or even in totaling the degrees of temperature for the growing season. Although more attention has been given to the temperature phenomena of the growing season, he believes that the temperature phases of the frost season are perhaps of equal importance, especially in determining the distributional limits of some subtropical plants. He has already shown, as noted in this journal,[25] that the temperature conditions in mountains is often complicated by cold air drainage, but it would appear that in such situations winter temperatures are effective in determining the vertical limits of many species. Observations show that the number of consecutive hours of freezing temperature is the factor most closely corresponding in its distribution with the limitation of the species concerned. This would harmonize with SHREVE'S[26] experiments with the giant cactus, which show that the number of hours of exposure to temperature below freezing determines its death, without regard (within certain limits) to the absolute minimum reached. Thus *Cereus giganteus* is unable to resist freezing of over 19–22 hours duration, while other related Arizona species withstood periods up to 66 hours, and *Opuntia missouriensis* has been known to survive 375 consecutive hours of freezing temperature in Montana. The importance is thus emphasized of applying the exact quantitative methods of physiological work to plant geography in order to place its generalizations upon a secure logical basis.

In this connection it is interesting to note the method described by McDOUGAL[27] of applying to the summation of temperature in hour-degree units for a given time a factor expressing the rate of growth of a particular species, in order to give the relative values of such temperature exposures.—GEO. D. FULLER.

Production of alcohol by higher plants.—MINENKOW,[28] investigating the question of alcohol production by higher plants fully aerated, and the influence of osmotic pressure and temperature on the process, finds that well aerated, sterile solutions of glucose (15.8 per cent), sodium sulphate (6–7.8 per cent), and di-potassium hydrogen phosphate (7.25 per cent) retard germination of *Vicia Faba* and favor alcoholic production so that the ratio of carbon dioxide to alcohol approached nearer the value observed for alcoholic fermentation than with seeds germinating in water. Growth was retarded by these

[25] BOT. GAZ. **55**:263. 1913.

[26] SHREVE, F., The influence of low temperature on the distribution of the giant cactus. Plant World **14**:136–146. 1911.

[27] McDOUGAL, D. T., The auxo-thermal integration of climatic complexes. Amer. Jour. Bot. **1**:186–193. 1914.

[28] MINENKOW, A. R., Die alkoholische Gärung höherer Pflanzen. Biochem. Zeitschr. **66**:467–485. 1914.

solutions. With increasing concentrations of glucose (4–14 per cent), mannite (4–14 per cent), and Hellriegel's nutrient solution, there is a corresponding retardation of growth and increase of alcohol production. Low or high temperatures which retard growth also favor alcohol production, while at intermediate temperatures favoring growth alcohol production is decreased. The author therefore concludes that alcohol is produced by higher plants even under conditions of complete aeration, and correlates alcohol production with retardation of growth. It is immaterial whether the retardation of growth is brought about by unfavorable temperatures, high osmotic pressures, or other factors.—H. HASSELBRING.

Vegetation about Tucson, Arizona.—SHREVE[29] has compiled an excellent brief but comprehensive guide to the features of ecological interest in the vicinity of Tucson, Arizona. In addition to the better known desert and semidesert areas immediately surrounding the city, he has included the more diversified conditions found in the adjacent Santa Catalina mountains. Starting with a desert formation at 900 meters, in which *Cereus giganteus*, *Opuntia* spp., *Echinocactus*, and *Fouquieria splendens* are conspicuous, the desert forms are found to disappear with increasing altitude, grasses and shrubs becoming more abundant, until at 1550 meters upon the north-facing slopes there is an open forest of such species as *Juniperus pachyphloea*, *Quercus oblongifolia*, *Q. Emoryi*, *Arctostaphylos pungens*, *Rhus trilobata*, and other woody forms. A further ascent of some 500 meters reveals forests of *Pinus arizonica* and smaller stands of other pines and oaks, with specimens of *Arbutus arizonica*. Finally, at 2350 meters this interesting succession finds its climax upon slopes forested with *Pseudotsuga*, *Abies concolor*, and *Pinus strobiformis*, with even more mesophytic forms along the water courses and in the undergrowth. A brief analysis is also presented of the factors which cause this diversity of vegetation. —GEO. D. FULLER.

Water reaction in a liverwort.—CANNON[30] reports experiments with a species of *Plagiochasma* found upon arid slopes of the Santa Catalina mountains, Arizona, at an altitude of 5000 feet, showing that the thalli are able to become air dry, involving the loss of over 70 per cent of their original weight; but upon being given water again they continued to grow without apparent injury. He has also demonstrated that these plants may endure such a desiccated condition for at least 25 days, and upon their restoration to moist conditions at once assume active growth. These experiments show clearly that this liverwort can withstand in nature conditions of extreme aridity.—GEO. D. FULLER.

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[29] SHREVE, FORREST, A guide to the salient physical and vegetational features of the vicinity of Tucson, Ariz. International Phytogeographic Excursion in Amer. pp. 11. 1913.

[30] CANNON, W. A., A note on the reversibility of the water reaction of a desert liverwort. Plant World **17**:261–265. 1914.